Appendices

Appendix A: Technical Notes

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Appendix A: Technical Notes

Age-Adjustment

Age-adjusted incidence rates were developed using the direct method. They were standardized to the age distributions of the United States 2000 standard population. Following the age-adjustment procedures used by the National Cancer Institute we used five-year age groups in calculating age-adjusted rates. The age distribution of the 2000 US standard population is shown below.

US Standard Population Proportions

age group	2000 proportion
0 - 4	0.0691
5 - 9	0.0725
10 - 14	0.0730
15 - 19	0.0722
20 - 24	0.0665
25 - 29	0.0645
30 - 34	0.0710
35 - 39	0.0808
40 - 44	0.0819
45 - 49	0.0721
50 - 54	0.0627
55 - 59	0.0485
60 - 64	0.0388
65 - 69	0.0343
70 - 74	0.0318
75 - 79	0.0270
80 - 84	0.0178
85+	0.0155

Direct method of age adjustment

Multiply the age-specific rates in the target population by the age distribution of the standard population.

$$\hat{R} = \sum_{i=1}^{m} s_i (d_i / P_i) \;=\; \sum_{i=1}^{m} w_i d_i$$

Where m is the number of age groups, d_i is the number of deaths in age group i, P_i is the population in age group i, and s_i is the proportion of the standard population in age group i. This is a weighted sum of Poisson random variables, with the weights being (s_i / P_i).

Confidence Intervals

Confidence intervals for the age-adjusted rates were calculated with a method based on the gamma distribution (Fay and Feuer, 1997). This method produces valid confidence intervals even when the number of cases is very small. When the number of cases is large the confidence intervals produced with the gamma method are equivalent to those produced with the more traditional methods, as described by Chiang (1961) and Brillinger (1986). The formulas for computing the confidence intervals are given below. Although the derivation of this method is based on the gamma distribution, the relationship between the gamma and Chi-squared distributions allows the formulas to be expressed in terms of quantiles of the Chi-squared distribution, which can be more convenient for computation.

$$\text{Lower Limit} = \frac{v}{2y}\left(\chi^2\right)^{-1}_{\frac{2y^2}{v}}\left(\alpha/2\right)$$

$$\text{Upper Limit} = \frac{v+w_M^2}{2(y+w_M)}\left(\chi^2\right)^{-1}_{\frac{2(y+w_M)^2}{v+w_M^2}}\left(1-\alpha/2\right)$$

where y is the age-adjusted death rate, v is the variance as calculated as shown below, w_M is the maximum of the weights s_iP_i , $1-\alpha$ is the confidence level desired (e.g., for 95% confidence intervals, α = 0.05), and $\left(\chi^2\right)^{-1}_x$ is the inverse of the χ^2 distribution with x degrees of freedom.

$$v = \sum_{i=1}^{m} d_i\left(s_i/P_i\right)^2$$

References

Brillinger, D. R. The natural variability of vital rates and associated statistics [with discussion]. *Biometrics* 42:693-734, 1986.

Chiang, C. L. Standard error of the age-adjusted death rate.*Vital Statistics, Special Reports* 47:271-285, USDHEW, 1961.

Fay, M.P. and Feuer, E.J. Confidence intervals for directly rates: a method based on the gamma distribution. *Stat Med*16:791-801, 1997

Appendix B: Sources of Additional Information

For more information on cancer, risk factors or prevention strategies please refer to the following resources:

1-800-4CANCER: A cancer information service of the National Cancer Institute

American Cancer Society, Western-Pacific Division: 1-800-729-1151 ext. 3307
American Cancer Society. 1998 Cancer Facts and Figures
American Cancer Society website, http://www.cancer.org/

National Cancer Institute. Cancer Net: A Service of the NCI, http://cancernet.nci.nih.gov/

Schottenfeld, David and Fraumeni, Joseph F. Jr. Cancer Epidemiology and Prevention, Second Ed. Oxford University Press, 1996.

Washington State Department of Health. Health of Washington State. September 1996.

Fred Hutchinson Cancer Research Center website: http://www.fhcrc.org/science

American College of Surgeons National Cancer Database website: http://www.facs.org

National Program of Cancer Registries website: http://www.cdc.gov/cancer/index.htm